Sheer, Hermann. (2001). *A Solar Manifesto: The Need for a Total Energy Supply and How to Achieve It.* New York: Earthscan Publications.

Silberglitt, Richard, Emile Ettedgui, and Anders Hove. (2002). "Strengthening the Grid: Effect of High-Temperature Superconducting Power Technologies on Reliability, Power Transfer Capacity, and Energy Use," at http://www.rand.org/publications/MR/MR1531/.

Smith, Rebecca. (2004). "Not Just Tilting Anymore." *Wall Street Journal* (October 14), C1.

Stigler, George J. (1971). "The Theory of Economic Regulation." *Bell Journal of Economics and Management Science* 2 (Spring): 3-21.

U.S. Department of Energy, Energy Information Administration. (2000). *Modeling Distributed Electricity Generation in the NEMS Buildings Models*. Washington, DC: Department of Energy.

U.S. Department of Energy, Energy Information Administration. (2003) Form EIA-860 Database, Annual Electric Generator Report, at http://www.eia.doe.gov/cneaf/electricity/page/eia860.html.

U.S. Department of Energy, Energy Information Administration, Annual Energy Review 2003 (2004), at http://www.eia.doe.gov/emeu/aer/txt/ptb1306.html

U.S. Department of Energy. (2005a). Energy Information Administration Statistics, athttp://www.eia.doe.gov/emeu/mer/pdf/pages/sec9_14.pdf.

U.S. Department of Energy. (2005b). "Electric Power Annual 2003," at http://www.eia.doe.gov/cneaf/electricity/epa/epa.pdf.

Wiser, Ryan and Ole Langniss. (2001). "The Renewables Portfolio Standard in Texas: An Early Assessment." *Lawrence Berkeley National Laboratories Report LBNL-49107*.

Yacobucci, Brent D. and Aimee E. Curtright. (2004). "A Hydrogen Economy and Fuel Cells: An Overview." *CRS Report for Congress* (January 14). Library of Congress: Congressional Research Service.

One Man One Vote: Trust between the Electorate, the Establishment, and Voting Technology

Laurie Robertson

Election Day 2004: A voter arrives in person to a polling location, which although a temporary setup projects an image of impartial integrity. Bland signage, temporary tables, voting machines and other election paraphernalia turn a school gymnasium or a civic center into a sacred space. Upon entering the polls a voter approaches a table where a series of rituals (e.g., appropriate identification, verbal affirmation of name and residence) verify his or her registration and identity. After the officials perform a mysterious rite with the poll book, the voter is provided with a sacred token, be it a paper polling pass or a DRE smart card, and is admitted to vote. The voter exchanges the sacred token with an official who escorts the voter to the hallowed machine with allows him to perform the holy rite of democracy – voting. Ordained election officials protect the integrity and sanctity of the machines and space throughout the day and it is these officials who perform the all-important, but private ceremony, of the tally and report of the votes. After this official sanctification, the results are publicly ordained and once again the "voice of democracy has spoken."

Of course, voting realities are much messier than this idealized account promulgated by the electoral establishment. The seminal image of

Election 2000 was the Florida election official behind a magnifying glass examining a circa-1960s mainframe computer punch card with Republicans and Democrats arguing the legal fine points about hanging chads. For the electoral establishment, which presents itself as a protector of voting integrity, it was a retro-embarrassment. It was "obvious" to legislators, lawyers, and election officials that "obsolete" voting technology had failed and the perpetuation of American Democracy required a massive technological upgrade. As a result, in 2002, Congress passed the Help America Vote Act (HAVA), which provided over $325 million for states and localities to upgrade their current "presumably obsolete" voting technologies. For technological advocates "modern" electronic voting equipment, many designed using banking's "familiar" automated teller machine (ATM) paradigm, would solve many if not most of Election 2000's technological problems.

However, most academic and popular post-Election 2000 critiques (especially the many electronic voting accounts) focused on voting technology and overlooked the fact that voting machines and systems are technologically-situated. Technological advances completely outside the electoral realm can significantly impact the perceived "trustability" of a voting technology. For example, in the late 1800s, mechanical lever machines were introduced as a "state-of-the art" advance from handwritten ballots to "solve" the problem of human interpretation and ballot box tampering. With the emergence of mainframe computers in the 1960s, mechanical lever machines seemed "old-fashioned" and "state-of-the-art" optical and punch card technology offered a modern mechanism to rapidly process results and "solve" human calculation errors. Now with widespread personal computing and banking automated teller machines, the mainframe technologies that epitomized Florida 2000 seem antique and the rush is on to replace them with more "accurate" state-of-the-art electronic voting technology.

Historically any U.S. voting technology is burdened from its very inception with the expectation of technologically ensuring voting integrity. Beginning with Thomas Edison in 1869 and continuing today, numerous U.S. manufacturers have produced machines and systems to "protect the voter from rascaldom" (Phillymag). Voting is an officially sanctioned social activity/ritual in a technologically-focused nation, so U.S. voters arrive at the polls expecting that voting technology will ensure that their vote "counts."

But no matter what voting technology is used, any election system must be approachably voter friendly while simultaneously satisfying hard technical criteria such as system reliability and availability, integrity, data confidentiality, operator authentication, and system accountability (Mercuri, 33-34). Forgotten in the post-Election 2000 rush to modernize is the perception risk inherent in any technological transition. Even "primitive" election techniques such as paper ballots bear the imprimatur of established voting technology. In the case of electronic voting machines, voters and election officials must gain confidence and comfort with the new technology. Until that occurs, the number of voting errors (probably mostly unintentional) may actually increase. For example, the Caltech/MIT Voting Project statistically analyzed voting results in all U.S. counties that changed their voting technology between 1988 and 2000 and found that only optically scanned ballots offered similar rates of reliability (as measured by residual voting) as lever machines. Despite their ballyhooed promises, Direct Recording Electronic (DRE) machines performed equivalently well as "discredited" punch cards and significantly worse than paper ballots (Alvarez). Conduct this transition in an environment of electoral and media hysteria and it is not surprising that public confidence in the establishment is shaken.

The mantra of the U.S. voting establishment is "One man, one vote," so it is understandable that voting machines are the lightening rods for electoral integrity, but voting is a process performed and administered by humans. No matter what voting technology is used, cumulatively individual mistakes and misperceptions can undermine voter confidence. Electronic voting machines may be problematic, but so are the other election technologies. There will never be a perfect election, but perception is everything. Today, voter concerns regarding electoral integrity are epitomized by not only by past (e.g., punch cards) but current (e.g., DREs) computerized voting technologies. Voters want to believe that their vote counts and that it is counted properly. Post-Election 2000, the election establishment is under increasing scrutiny and technology alone will not solve the problem.

Ironically the current electronic voting hysteria focuses on one of the more trustworthy

components – the technology of voting. Individual voting technology, such as lever machines, punch cards, and DRE may be problematic, but they are only a part of an underlying electoral establishment. It is here that numerous new technological issues emerge. Voters need to believe that their vote actually "counts" otherwise they will not bother to participate. Procedural rituals such as voter registration, poll-side voter identification, and official ratification are designed to create trust in the overall voting establishment. The modern U.S. voting establishment bases its legitimacy by pre-qualifying and registering acceptable voters prior to an election, then on election day publicly verifying their acceptability prior to permitting them to anonymously vote, then performing elaborate official post-electoral rituals to reconcile any voting discrepancies. This admirable Norman Rockwell-type portrayal was never attainable but especially not in this post-Election 2000 world. Although most electronic voting accounts focus on technological disenfranchisement, there are numerous other non-DRE means by which a voter may end up disenfranchised and most do not involve technology.

Underlying the United States voting process/establishment there is a fundamental paradox – a citizen must personally publicly certify his or her identify prior to being permitted to vote anonymously. Consequently, any U.S. electoral mechanism be it manual or electronic, is expected to produce an official trusted auditable record of anonymous votes cast by approved voters. In the idealized election establishment world, jurisdictions vet, pre-approve and publish on approved voters on registration roles; on Election Day officials challenge prospective voters to validate their legitimized identity and if approved the individual voter is allowed to vote anonymously. Over time, various registration voting and validation rituals have evolved – from the registration oath (even if administered in a grocery store by a League of Women Voters' representative) to the name and address declaration at the precinct poll books.

Successful voter registration is a critical entry point for voting in most U.S. jurisdictions. Voters who identify themselves, affirm their eligibility, and declare their intent to vote are added to the election rolls from which poll books are produced containing lists of the approved voters for an election. Poll books in most jurisdictions serve as the primary gatekeepers for voting. Affirmed voters listed in the book are permitted to vote and the overall experience is positive; but for unlisted voters the experience may quickly degenerate into a frustration of potential disenfranchisement. Even in today's post-1960s Civil Rights and Election 2000 environment, the electoral landscape consists of a mind-numbing number of widely-varying state and local procedures to handle not only routine but especially anomalous voting circumstances. Given this patchwork of voting laws and procedures it is not surprising that many denied voters are left with the impression their right to vote was unfairly denied.

Although most jurisdictions use computers to maintain their voter registration lists and produce their poll books, technology is not usually at fault here. Typically, an individual doesn't appear in the poll book because he or she moved and didn't update their registration, he or she didn't register in time, or he or she hadn't voted for a significant period of time and were dropped from the rolls. These long-standing factors are social not technological; however, recently Federal legislation has muddled the situation and introduced unanticipated technological consequences. Today, a registered voter may requested to produce an "H" (the Arlington County Virginia code for post-Help America Vote Act [HEPA] registered voters) acceptable form of identification; and here Federal and state laws regarding acceptability vary considerably. For example, Virginia state law accepts employer photo identification as an affirmation of identity; while other states and Federal (HEPA) standards disallow it. Given these continuing jurisdictional inconsistencies it shouldn't be surprising that individual disenfranchisement persists in electoral debate. The question to be asked is how much is intentional and how much is inadvertent.

Elections are administered by a small core of professionals who oversee a large army of volunteers that provide not only labor but the personal face of the electoral establishment. These well-intentioned volunteers, with their varying experiences, temperaments, and abilities are provided with rudimentary training, then officially sanctioned and thrown together to administer an election. Their personal demeanor and decisions can significantly affect whether a voter feels enfranchised or not. Unfortunately

training for these volunteers is woefully inadequate. Many jurisdictions conduct two- to four-hour classes for the poll workers in which they try to cram in basic election logistics, machine and polling place operations, and procedural checks and balances, but with so much to cover there is little time to assimilate the material. Furthermore, on Election Day these individual volunteers, who may or may not know each other, are thrown together and expected to operate as a team. The election establishment could easily improve the quality of its volunteer workforce by conducting more hands-on training and training precincts staff together.

In the post-Election 2000 climate, voters are extremely sensitive to perceived improprieties and any non-routine event can be cause for suspicion. Although most voting is routine (i.e., voter is verified, voter is admitted, voter votes), there are also anticipated non-routine events (e.g., special registration codes). Some jurisdictions provide election officials with "What If" reference sheets to assist in these non-routine situations while others rely upon individual judgment. As a result, a given situation (e.g., voter does not have appropriate identification) may be handled differently by different volunteers in different jurisdictions. For example, at one precinct a voter without identification may be denied entry, at another given a provisional ballot, while at a third given an affirmation of identity form. These inconsistencies are primarily inadvertent but they undermine the public's confidence in the electoral system. The election establishment could easily improve the consistency of non-routine events by providing poll workers with standardized state-wide reference sheets.

Voting technology was a prominent Election 2004 focus. In the wake of Florida's spectacular Election 2000 meltdown and numerous reports of pre-Election 2004 technological failures, voters entered the polls extremely sensitive to any hint of disenfranchisement. Many jurisdictions had used the post-Election 2000 Congressional HAVA money infusion to upgrade their voting machines to more modern technology, but for their voters this was the first election using new "state of the art" technologies such as computerized touch screen Direct Recording Entry devices. Due to this combination of voter technological unfamiliarity and hysterical pre-election publicity. The electorate voted warily. Sensitized to and "educated" about numerous "short-comings" of DRE technology, voters in Election 2004 came to the polls anticipating technological disenfranchisement. Congress and the electoral establishment pursued technological fixes, but slighted the social environment and implications of their deployment. The electoral establishment needs to recognize that most voters are not familiar with the full body of election procedure and how non-routine events may be perceived by the average voter in line. For example, Virginia law allows a physically disabled voter to vote outside the polls and in Arlington, this requires disconnecting a DRE device and taking it outside; this is in fact an anticipated non-routine event (in fact poll workers were trained on it), but in my precinct it caused considerable concern for several voters waiting in line. The election establishment could easily allay voter concerns by providing simple signage for non-routine events (e.g., signage for "Curbside Voting" or for routine poll book codes such as "H" means they registered after HAVA) would greatly alleviate many voters' post-Election 2000 concerns.

For Langdon Winner, technologies embody their politics and no technology is more political than election machines; however there is a significant inverse difference – while Winner sees politics embodied by technologies, voting machines are technologies encumbered by politics. U.S. voters go to the polls expecting that the U.S. voting establishment has provided them with a technological voting system that will ensure their votes are counted. When the system fails, as so many modern technologies do, the first inclination is to blame the technology. Voting machines are only a part of the overall electoral system but they are the most visible, attracting the focus of the both the popular press and academics.

As a technology, voting machines – from "obsolete, problematic" punch cards to "modern, unreliable" computer devices – have become the poster-children for post-Election 2000/2004 voting controversies, but as this article has shown despite their popular prominence voting machines are only a technology situated within an electoral infrastructure. While voters and the popular press obsess about new or obsolete voting technology, the overall establishment remains pretty much unchanged; consequently, it should not be unexpected to read about controversies in Election 2008.

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References

Alvarez, R. Michael, Stephen Ansolabehere, Erik Antonsson, et al., "A Preliminary Assessment of the Reliability of Existing Voting Equipment (Version 1)," The Caltech/MIT Voting Project, February 1, 2001.

Boyle, Alan, "e-Voting Flaws Risk Ballot Fraud," MSNBC, July 24, 2003.

Century Foundation, "Understanding the Debate Over Electronic Voting Machines."

Cranor, Lorrie Faith, "Voting After Florida: No Easy Answers," *ACM Ubiquity*, 2001.

Fund, John. *Stealing Elections: How Voter Fraud Threatens Our Democracy*. San Francisco: Encounter Books, 2004.

Gritzalis, Dmitris, ed. *Secure Electronic Voting*. Boston: Kluwer, 2003.

Harris, Bev. *Black Box Voting*. Renton: WA: Talion, 2004.

Help America Vote Act of 2002 (Public Law 107-252) October 29, 2002.

Kohno, Tadayoshi, Adam Stubnblefield, Aviel Rubin, Dan Wallach, "Analysis of an Electronic Voting System," *IEEE Symposium on Security and Privacy* 2004 [to be published] (previously published as Johns Hopkins University Information Security Institute TR-2003-19)

Mercuri, Rebecca and Peter Neumann, "Verification for Electronic Balloting Systems" in *Secure Electronic Voting* (Ed). by Dmitris Gritzalis, Boston: Kluwer, 2003, 31-42.

Phillymag, "The Clan Behind the Curtain," *Philadelphia Magazine*, May 2001 (available online http://www.phillymag.com/Archives/2001May/clan_1.html).

Verton, Dan and Patrick Thibodeau, "Electronic Voting Systems Pass Their Big Test – Maybe," Computerworld, Novermber 8, 2004.

Virginia State Board of Elections. *Elections in Virginia: An Overview of the Current System*. May 2001.

Virginia State Board of Elections. *Help America Vote Act of 2002: Virginia State Plan*. July 31, 2003.

Welsh, William, "Early Returns: E-voting Official Gather Lessons Learned from 2004 Presidential Election," *Washington Technology*, November 22, 2004.